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Pointing and Centering Systems in the NIF Laser Chain

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(oral presentation preferred)

Abstract

The operational requirements of the National Ignition Facility (NIF) place tight constraints upon its alignment system. All 192 beam lines must be accurately, precisely, and promptly aligned. In order for alignment to be completed within the allotted time, automated, parallel procedures must be implemented. In both the preamplifier module and the main laser, mirrors must be oriented so that the pulse is pointed and centered correctly each time it passes through an amplification stage. Alignment lasers will be used between NIF shots to correct any pointing errors. Pointing of the alignment lasers are surveyed within each of the three NIF spatial filters. The far field alignment laser profiles, located at the pinhole planes, are imaged and pointing errors are extracted from the images. Fiber sources, permanently mounted outside the main beam path on the optical axis behind spatial filter pupil plane locations, are used to correct beam centering. The near field images of the fiber sources are captured, centering errors are extracted from the images. Cross coupled mirror motions null pointing and centering errors.

The pointing survey system consists of a CCD camera configured to view the pinhole plane. A holographic beam sampler replicated on a fused silica substrate and a reference mask containing a reticular mark are introduced in the pinhole plane. The reference mark is centered on the axis of the shot pinhole by a high precision positioner. The camera records an image from which the mark's centroid is calculated. The mark is removed and the alignment beam is introduced. The camera records an image from which the beam's centroid is calculated. The automated control system uses the calculated δx and δy offsets to reposition mirrors in a closed loop manner.

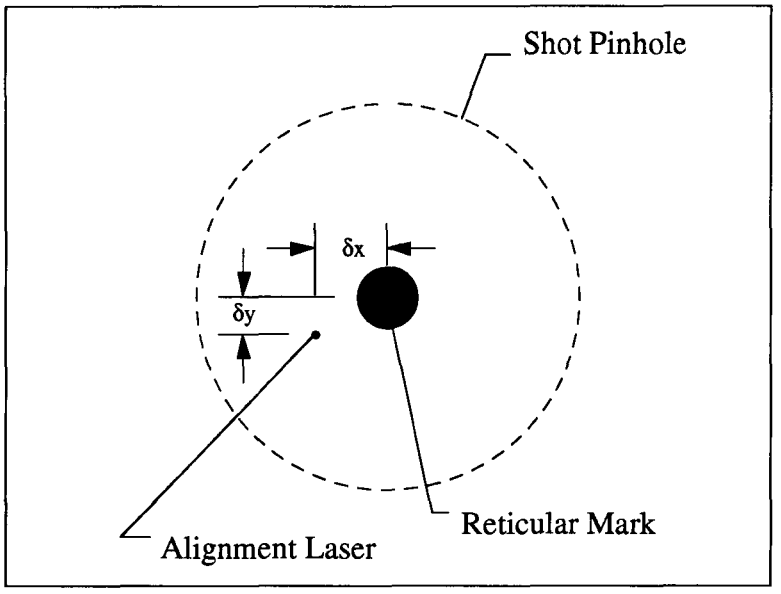

Figure: The camera views the pinhole plane, recording locations of the reticular mark and the alignment laser.

We describe the alignment system set forth in the NIF Title I design, detailing the pointing survey system prototypes. We compare the performance, price and NIF system compatibility of several reference masks.

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